Method and system for stabilizing video data

FIELD OF THE INVENTION

The present invention relates to a method for stabilizing video data and to a stabilizing system for carrying out said method.

BACKGROUND OF THE INVENTION

Miniaturization of video cameras in the recent years and inclusion of powerful zooms have led in these devices to an image stability problem, owing to the movement of the handheld video camera. Digital image stabilizing (DIS) systems have then been developed in order to remove this unwanted camera movement – or jitter – and thus to produce a sequence displaying requisite camera movement only and providing a more pleasant viewing experience. Jitter, defined as all the undesired positional fluctuations (translation, rotation, etc…) of the image that are added to the intentional motion of the camera, can have a lot of significant adverse effects (for example, on motion estimation coding, since it may increase the magnitude or the number of the motion vectors and therefore a decrease in the run length of encoded motion vectors). In most DIS systems, a motion estimation is performed between two successive frames (at times t-1 and t) in order to get the global motion of the image frame. Said global motion is represented by a single vector called the global motion vector GMV(t). The problem is that the successive values GMV(t) contain both the intentional motion and the unintentional one (jitter).

The document "Fast digital image stabilizer based on Gray-coded bit-plane matching", IEEE Transactions on Consumer Electronics, vol.45, n°3, August 1999, pp.598-603, describes a motion correction system allowing to decide whether the motion is intentional or not. To that end, the global motion vector is integrated with a damping coefficient, and the integrated motion vector IMV(t) thus defined designates the final motion vector correction to be applied to the current raw frame for motion correction. This integrated motion vector, provided for constructing a stabilized sequence, is given by the expression (1) :

$$IMV(t) = a \, . \, IMV(t-1) + GMV(t) \qquad (1)$$

where GMV(t) is the global motion vector for the current frame considered at the time t and a is a number comprised between 0 and 1 and playing a role according to which the integrated motion vector converges to zero when there is no camera motion. The choice of this number a, which is a damping factor, depends on the degree of stabilization desired, but it is crucial considering the type of camera motion, and the use of a constant value (for example) is often sub-optimal.

In fact, separating the intentional motion from jitter over the course of a sequence is always a complex problem. For a real-time application, the main constraint is moreover that no delay is allowed, i.e. it is not possible to store some frames in memory and to apply the motion correction later, once the movement can be better known. All the solutions proposed to that end in the literature have more or less the same drawback : the jitter is attenuated – but not cancelled – in portions of sequences that have a low amplitude jitter and fixed position, but as soon as there is a panoramic motion or any other type of strong camera motion, the output filtered sequence hardly follows the real motion or follows it after a long delay. Moreover, the sampling window used for filtering causes a delay that is noticeable when correcting low amplitude jitter. There is consequently always to find a trade-off between the strength for attenuating low amplitude jitter and the ability to follow intentional motion with a delay as low as possible.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to propose a filtering method allowing to perform an improved motion correction.

To that end, the invention relates to a method for stabilizing a video recording of a scene made by a video camera and represented by video data, said method comprising the steps of :

- subdividing said video data into a plurality of successive frames ;
- dividing each of said successive frames into a plurality of blocks ;
- determining for each block of each frame a motion vector representing the direction and magnitude of the motion in said block, said vector GMV at an instant t being called global motion vector GMV(t) and representing said motion at the instant t with respect to the previous frame ;
- defining a modified vector, called integrated motion vector IMV(t) at the instant t and designating the final motion vector correction to be applied to the current frame in view of its motion correction, said integrated motion vector being given by the expression :

$$IMV(t) = GMV(t) + a(E) . IMV(t-1)$$

where GMV(t) is the global motion vector of the current frame at the instant t, a(E) is a variable adaptive factor depending on an expression E and IMV(t − 1) is the integrated motion vector corresponding to the previous current frame ; and

- modifying the video data according to the modified integrated motion vectors defined for each successive current frame.

In a preferred embodiment, said variable adaptive factor depends on the sum of the two last global motion vectors.

Preferably, the variable damping factor is calculated independently for the horizontal and vertical coordinates of the IMVs and GMVs, and thus the filtering along the two axes is always independent from each other.

It may also be checked if the IMV correction is not above a given threhsold, corresponding to the extra input area authorized : if so, the correction is modified in order to stay within a predetermined allowed range, +/– 16 pixels for example.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described, by way of example, with reference to the accompanying drawings in which:

Fig.1 is a table giving some examples of the value of the damping factor value used in the stabilizing method according to the invention ;

Fig.2 illustrates the advantage of the stabilizing method according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

In accordance with the present invention, a stabilization method is proposed in which the proposed correction is now equal to the integrated motion vector IMV(t) previously defined, but with a damping coefficient denoted a(E) and which is now a variable adaptive factor :

$$IMV(t) = a(t, t\text{-}1, \ldots) . IMV(t-1) + GMV(t) \qquad (2)$$

In this expression (2), the damping factor a(E) is now no longer a constant value, but an adaptive one depending for instance on the sum of the two last global motion vectors. This allows to track the beginning of intentional motion (the last global motion vector being usually too instable to be used per se).

The correspondence table between the damping factor a(E) and the sum (GMV(t) + GMV(t-1)) of the two last global motion vectors is built in the following way :

(a) a low sum of GMV values implies a high damping factor value, which strongly stabilizes the sequence, as if assuming static intentional camera ;

(b) a high sum of GMV values implies a low damping factor value, and the sequence then follows more precisely the original motion.

An example of damping factor values DFV versus increasing sums SLG of the last two global motion vectors in quarter pel units is given in the table of Fig.1.

Some additional features may be proposed. It is for example advantageous if one has a filtering on the x-vector independent of y-vector filtering. Moreover, an out of bounds detection may be provided : said detection allows to check if the IMV correction is not above a given threshold, corresponding to an extra input area authorized, and to correct it to stay within an allowed range, for instance +/- 16 picture elements (pixels).

The proposed stabilizing method thus creates long stabilized shots when jitter is centered around a certain spatial position, while following intentional motion when the motion is too high, as illustrated in Figure 2 which shows simultaneously the original motion (curve A), the motion conventionally filtered by a moving average filter (curve B), and the curve M of the motion filtered by the stabilizing method according to the invention (for these three curves, the horizontal axis corresponds to the number of frames NOF and the vertical one to the cumulative displacement, i.e. to the sum SLG of the global motion vectors). Some fast moving transitions are still visible, but they generally correspond to abrupt motion in the original sequence that must be followed in some way, if one wants to stay within the allowed extra image bounds. The stabilizing method is also effective in tracking slow moving motion.